

# TECHNICAL NEWS BULLETIN OF THE BUREAU OF STANDARDS

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### COOPERATION WITH FOREIGN NATIONAL LABORATORIES

For many years the National Bureau of Standards has cooperated with the leading foreign national laboratories, notably those of Germany and England, in maintaining uniformity of those standards for which there has been no international coordinating agency. Uniformity of the fundamental standards of length and mass has been maintained by the activity of the International Bureau of Weights and Measures. The maintenance of many other standards, such as those for electricity, photometry, temperature, etc., has been left to the several national laboratories. The advantages of frequent intercomparisons of the national standards in promoting uniformity of standards were recognized at an early date, and there have been numerous interchanges of standards among the various laboratories. Recently a proposal of the bureau for an interchange of personnel between the national laboratories was accepted by the Physikalisch Technische Reichsanstalt and Prof. Dr. F. Henning, chief of the division of heat and pressure of the Reichsanstalt, came to the bureau to collaborate on problems of temperature measurement and in investigations of the use of black bodies as standards of light. To complete the exchange, Dr. G. W. Vinal, of the National Bureau of Standards, is now at the Reichsanstalt engaged in investigations of electric standards.

Professor Henning brought to the bureau two platinum resistance thermometers which were part of a group that had been used in an intercomparison (not yet completed) of the standards of the National Physical Laboratory of Great Britain, the Reichsanstalt, and the National Bureau of Standards. He also brought standard thermocouples and some special lamps for which the current-temperature relation had been determined, so that means were available for making comparison over the entire range covered by the International Temperature Scale.<sup>1</sup> The work done on the intercomparisons of the temperature scales illustrates very well the advantages of the modern tendency to use, wherever possible, standards which are reproducible from definitions. In comparing the Reichsanstalt's resistance thermometers with those of the bureau, for example, exactly the same procedure was followed as would have been necessary if all the working standards had been destroyed. The thermometers were first calibrated at the ice point, steam point, and the boiling points of sulphur and oxygen, and were then used to measure other temperatures, such as the freezing points of antimony, lead, tin, and mercury, and the normal sublimation point of CO<sub>2</sub>. The new calibrations and measurements were found to be

<sup>1</sup> B. S. Jour. Research, Vol. 1, (RP22), p. 635; 1928.

in agreement with those previously made at the bureau or at the Reichsanstalt within  $0.02^\circ$  or  $0.03^\circ$  in all cases, and for most of the points, the agreement was very much better. Thus it was shown to be possible, in the course of a few weeks to reestablish the temperature scale with high accuracy, even if no calibrated standards were available at the start. Similar results were obtained in intercomparisons of thermocouples, and in measurements of high temperatures with optical pyrometers.

Professor Henning also collaborated in a new determination of the freezing point of iridium. The method used was the same as that used previously at the bureau for determining the freezing point of platinum, as described in Research Paper No. 326 in the June, 1931, number of the Bureau of Standards Journal of Research. This measurement is apparently the first accurate determination of this temperature, as the value found,  $2,452^\circ \text{C.}$ , is believed to be accurate within a few degrees, although it is about  $100^\circ$  higher than the previously accepted value for the melting point of iridium. Professor Henning is joint author of the paper in which this work is to be described.

Further measurements with black body standards of light were also made. A repetition of the measurements with the Waldner-Burgess standard<sup>2</sup> confirmed the results of the previous work. Measurements of the candlepower of a black body immersed in freezing iridium resulted in a preliminary value of  $1,222 \pm 10$  candles per  $\text{cm}^2$ , while the value calculated from the temperature was 1,220 candles per  $\text{cm}^2$ . The value found, 1,222 candles per  $\text{cm}^2$ , corresponds to a temperature of  $2,452.6^\circ \text{C.}$  Thus the photometric determinations and the temperature measurements are concordant far within the limits of accuracy measurement.

While the scientific results obtained during Professor Henning's stay at the bureau are of great interest and value, an even more important result is to be found in the promotion of better understanding and closer cooperation between the national laboratories which will enable them to work more effectively in establishing and maintaining uniform standards. Although no formal arrangements have yet been made for continuing these exchanges of per-

sonnel, the highly successful results of this first venture indicate that such exchanges would be a most valuable addition to the programs of the national laboratories.

#### INTERNATIONAL COMMITTEE ON WEIGHTS AND MEASURES

The regular biennial meeting of the International Committee on Weights and Measures held at Paris, April 10 to 18, 1931, was attended by Dr. S. W. Stratton, former Director of the National Bureau of Standards, who is the American member of this committee. Official reports of the meeting have not yet been issued, but informal reports indicate that satisfactory progress was made on several technical questions. In particular, the committee definitely adopted  $20^\circ \text{C.}$  ( $68^\circ \text{F.}$ ) as the normal temperature for adjustment of industrial standards for length measurements.

The committee also approved without change the resolutions regarding photometric and electrical units and standards submitted by its Advisory Committee on Electricity and Photometry. These resolutions were reported in full in TECHNICAL NEWS BULLETIN No. 164, 115 (December, 1930). In brief, the resolutions on photometry recommend the use of a "black-body" radiator as a primary standard of light, request other laboratories to give special study to the form of black body operated at the freezing point of platinum which has been developed at the National Bureau of Standards, ask all countries to accept the unit of light known as the International Candle, propose that the national standardizing laboratories cooperate in establishing and maintaining the common unit, and that any future adjustment of its value be made only by international agreement approved by the committee, and express the hope that agreement may soon be reached on a standard method of measuring lights of diverse colors.

With regard to electrical units, the conclusions are that values for the ohm in use in different countries are so nearly in accord that no adjustments will be necessary until it is found practicable to go over in all countries to an ohm based upon absolute measurements. For the volt, however, present values are so discordant that they should be checked by measurements with the silver voltameter.

<sup>2</sup> B. S. Jour. Research, Vol. 6 (RP325), p. 1103; 1931.

# INTERNATIONAL COMPARISON OF ELECTRICAL UNITS

It has been known for several years that the values of the electrical units in use in different countries were not exactly in accord, but an exact determination of existing differences was difficult because the standards could not be transported between countries without undergoing some changes. A new type of resistance standard developed at the bureau has, however, proved free from these changes in transit. By means of such resistance coils and of standard cells carefully carried by hand, direct comparisons have been made between the National Bureau of Standards and the national laboratories of Germany and of Great Britain several times during the last three years. These comparisons have shown that the British ohm is at least 2 parts in 100,000 larger than the American, while the German unit is about the average of the other two.

The British volt is likewise 2 parts in 100,000 larger than the American, but for this unit the German values are 6 parts in 100,000 below the American, or 8 below the British. In measurements of power or of energy this discrepancy is practically doubled; the German watt is 13 parts in 100,000 smaller than the American, and 15 below the British unit.

In accordance with recommendations of the International Committee on Weights and Measures (see preceding item) measurements with silver voltameters to determine the correct "international" value for the volt have been begun in several national laboratories. Fortunately it has been found possible to arrange for direct cooperation between the three laboratories mentioned: Dr. George W. Vinal, of the National Bureau of Standards, and Dr. J. E. P. L. Vigoureux, of the British National Physical Laboratory are now at the German Physikalisch-Technische Reichsanstalt carrying out voltameter measurements and comparing groups of standard cells.

## CONFERENCE OF STATE UTILITY COMMISSION ENGINEERS

The ninth annual conference of State utility commission engineers was held at the bureau on June 4 and 5, 1931. Twenty-five engineers, representing 16 States, the District of Columbia, and the Province of Ontario, Canada, attended the conference. The program was arranged by an executive committee consisting of George Charlesworth, electrical engineer, rail-

road commission, Iowa, chairman; A. E. Davison, transmission engineer, Hydro-Electric Power Commission, Ontario, vice chairman; E. I. Rudd, Connecticut; A. B. Greene, Florida; and Philander Betts, New Jersey.

The following papers and report were presented:

Problems arising from lack of complete commission jurisdiction over utility operation, C. B. Hayden, Wisconsin.

Commission methods for handling problems of inductive coordination, R. E. Duffy, Missouri.

Protection and elimination of grade crossings, J. G. Hunter, California.

Uniform rules for bus regulation, E. I. Rudd, Connecticut.

Regulation governing safety in construction and operation of impounding dams, G. P. Steinmetz, Wisconsin.

Some results of Bureau of Standards studies of underground corrosion, K. H. Logan, National Bureau of Standards.

Rural electrification standards, J. H. Mathews, Illinois.

Gas rates and service, Natural versus manufactured gas, F. J. Almgren, Alabama.

Prominent rate decisions, Harry Barker, Vermont.

The treatment of depreciation for valuation and accounting, John E. Goodwin, Maine.

Messrs. Almgren, Goodwin, Hunter, and Rudd were not present, and their papers were read by other members in attendance. The papers presented at the conference are not available for general distribution, but a few copies of some of them are available for distribution to commission engineers who were unable to attend.

The following engineers were elected members of an executive committee to make arrangements for the tenth annual conference in 1932: J. H. Mathews, Illinois, chairman; E. I. Rudd, Connecticut, vice chairman; A. B. Greene, Florida; R. H. Nexsen, New York; George Charlesworth, Iowa; and J. Franklin Meyer, National Bureau of Standards, secretary.

## CALIBRATION OF STEEL TAPE BENCH

During recent months a number of invar base-line tapes have been calibrated, when supported throughout, to determine the lengths of the 5-meter intervals. This provided an opportunity to check the 5 m intervals of the bureau's bench standard. ("Bench I.") The results are shown in the fol-

lowing table, values obtained in 1912 and 1922 being shown for comparison:

Interval (in meters)	Element of calibration of Bench I. (Basis that 0 to 50 m has zero correction)		
	1912	1922	1931
	mm	mm	mm
0 to 5.....	+0.07	+0.18	+0.17
0 to 10.....	-.01	+0.19	+0.19
0 to 15.....	-.28	-.08	-.10
0 to 20.....	-.22	-.06	-.10
0 to 25.....	-.16	-.02	-.06
0 to 30.....	-.20	-.14	-.23
0 to 35.....	-.10	-.07	-.14
0 to 40.....	-.17	-.09	-.05
0 to 45.....	-.08	-.03	-.08
0 to 50.....	.00	.00	.00

The calibrations in 1912 and 1922 were direct calibrations of the bench, using a least squares reduction of the observations which were made with one steel tape (B. S. No. 1313). In 1931 the measurements were made for the primary purpose of obtaining corrections to the tapes for which values to the 5 m intervals are reported to the nearest 0.1 millimeter; but using the mean of eight absolutely different determinations gives a very precise value. Probable errors must be used with caution in such a case as this. The least accurate value appears to be for the interval 0 to 35 for which the element of calibration has a probable error as computed from the eight deviations of 0.013 mm (13 microns). The interval 0 to 5 m was apparently determined with the greatest accuracy, the probable error for its element of calibration being only 0.005 mm (5 microns).

The correction to the 50 m interval on this bench was also redetermined recently. Measurements were made using 8 tapes, 7 of which were the same as used in the calibration of the subintervals. These 8 tapes had been measured on the geodetic tape comparator just prior to this investigation, and the length of each of the tapes supported throughout was computed using the customary catenary formula.

The length of the 50 m interval of this bench is now found to be 50.01136 m at 20° C. Taking into account simply the deviations of the eight sets of measurements, the probable error of this result is 0.00002 m (0.02 mm or 20 microns). The average deviation is 0.00008 m, and the maximum deviation 0.00012 m. Since the 50 m interval of the bench would change in length by 0.00002 mm with a

change in temperature of 0.03° C., the result is more precise than would be expected.

This 50 m interval had been previously measured in 1909 and in 1922. The values at 20° C. are:

	m
1909.....	50.01120
1922.....	50.01129
1931.....	50.01136

The 1909 measurements were made with 16 invar tapes, a total of 58 separate values being obtained with a probable error of the mean of these comparisons of 0.000011 m (0.011 mm or 11 microns) and a computed probable error of the mean total length of 0.000030 m (0.030 mm or 30 microns).

In 1922 the measurements were made with six invar tapes by comparison with Bench II, which had been tested a short time before. The probable error of the comparison of the two benches was 0.00003 m (0.03 mm or 30 microns).

In examining these results, it appears that a check on the calibration of the tape benches should be carried out about once a decade. These results, combined with the results of other tests made in recent years on the bureau's bench standards are proof that these steel tape benches are calibrated to an accuracy which is not only entirely adequate for the purpose but which is also entitled to high rank among physical measurements.

#### METERING LARGE VOLUMES OF AIR

A recent investigation of meters used for measuring large volumes of gas will be described in the July number of the BUREAU OF STANDARDS JOURNAL OF RESEARCH. In this study a gas holder 165 feet in diameter was used as an absolute standard in testing a rotary displacement gas meter, a 24 by 12 inch Venturi meter, and 4 square-edged thin-plate orifices installed, one at a time, in a smooth 24-inch pipe. The tests were made with air.

The temperature of the air in the holder, measured by electrical thermometers, was controlled by flooding the holder with a continuous stream of water, pumped up from the tank and allowed to run down again into the tank over the crown and sides. The experiments were made at night. After the holder had been filled with air by a centrifugal booster, the connections were changed so that the booster withdrew air and forced it

along the line in which the meters to be tested were installed in series. The rate of delivery was computed from the dimensions and rate of fall of the holder and observations of pressure and temperature.

The rated capacity of the rotary displacement meter was 200,000 cubic feet per hour, and the holder was undesirably large for rates lower than this, so that the precision of the measurements was less than for higher rates. Eight tests at rates between 38,000 and 173,000 cubic feet per hour gave a mean coefficient of 0.994, indicating that the meter ran 0.6 per cent fast with respect to the holder. The mean departure from the mean was  $\pm 0.4$  per cent.

Sixteen determinations of the adiabatic discharge coefficient of the Venturi, at rates between 307,000 and 612,000 cubic feet per hour, gave values from 0.986 to 0.994, with a mean of 0.990, a mean departure of  $\pm 0.003$ , and no evidence of a systematic run. If two values which appeared intrinsically less reliable than the others were omitted, the mean was 0.989 and the mean departure was  $\pm 0.002$ . The limiting factor in the precision was in the measurement of the fall of the holder rather than the temperature, and the four tests in which the measurements of the fall of the holder at the ends of two perpendicular diameters were most consistent gave the values  $C_a = 0.988, 0.988, 0.987, \text{ and } 0.988$ . The values of the Reynolds number, referred to the throat, varied in the 16 experiments between 660,000 and 1,290,000, with a mean of 870,000, the values for the 24-inch pipe being about half as large.

After the Venturi had thus been standardized it was used as a meter in testing 10 additional orifices. Supplementary observations were also made on the distribution of pressure along the pipe wall near the orifices, with at least two different rates of flow for each of the 14 orifices.

The most important results of the investigation are those relating to the discharge coefficients of the orifices. When these are so reduced as to be comparable with values for water recently published by R. Witte, the agreement is very good. They may be summarized as follows:

Let  $C$  be the discharge coefficient, defined in terms of "British absolute" or cgs. units by the equation

$$M = CA\sqrt{2(p_1 - p_2)\rho_1}$$

where  $M$  = the mass flow;  $A$  = the area of the orifice;  $p_1$  and  $p_2$  = the upstream

and downstream pressures observed at points 1 inch from the orifice plate; and  $\rho_1$  = the density of the air at  $p_1$  and the upstream temperature.

Let  $\beta$  = the ratio of the diameter of the orifice to that of the pipe;  $\alpha = (p_1 - p_2)/p_1$ ; and  $\gamma = C_p/C_v$  = the specific heat ratio of the gas. Then the results obtained may be represented within the limits  $\alpha < 0.08$  and  $0.2 < \beta < 0.77$  by the equation

$$C = KY$$

in which

$$K = 0.597 + 0.41\beta^4$$

and

$$C = 1 - (0.40 + 0.46\beta^4) \frac{\alpha}{\gamma}$$

These relations do not hold outside the stated limits of  $\beta$  nor for other locations of the pressure holes, but they probably do hold for considerably higher values of the fractional differential  $\alpha$ .

#### VISIBLE AND ULTRA-VIOLET ABSORPTION SPECTRA OF CAROTIN AND XANTHOPHYLL

The absorption spectra of equal molecular concentrations of pure carotin and xanthophyll in alcohol-ether solution have been studied throughout the visible and ultra-violet spectral range, and the changes in the absorption spectra followed as the pigments were allowed to oxidize slowly in solution.

The absorption spectra of the pure unoxidized pigments have essentially the same structure, and consist each of three groups of overlapping and partially resolved component bands. The bands for xanthophyll are sharper and closer together than the corresponding bands for carotin. By far the strongest group of bands for each pigment is located in the blue and violet regions of the visible spectrum. The frequencies (frequency =  $3 \times 10^8$ /wave length in millimicrons) of the components of these strong band groups are 602, 636, 672, 708, and 745 for xanthophyll, and 589, 625, 666, 712, and 764 for carotin. The ultra-violet band groups are relatively very weak, compared with the visible group, and the resolution into components is not so definitely indicated. The groups are centered at frequencies of 903 and 1,119, respectively, for xanthophyll, and at 882 and 1,098, respectively, for carotin. It is found, that, within the range of uncertainty of the experimental data, the three groups of component bands for each pigment form



a single regular sequence of bands, the frequencies of which are well represented by the parabolic equation

$$\nu - \nu_0 = a(n - n_0)^2$$

wherein  $\nu_0$ ,  $n_0$ , and  $a$  are constants, and  $n$  takes successive integral values. A periodic variation of intensity in the above progression of component bands gives rise to the appearance of the definite band groups and to the characteristic form of the absorption curves.

During slow oxidation in solution the spectrum of each pigment is observed to pass through the same series of changes until oxidation is complete. The carotin spectrum does not become identical with that of pure xanthophyll during this process; so that carotin is not oxidized to xanthophyll, as contended by some previous investigators.

The oxidation process proceeds in two definite stages which are the same for both pigments. The first stage corresponds to a marked increase in the intensity of the midultra-violet band group, accompanied by a small decrease in the intensity of the other bands. This characteristic change provides a sensitive test for incipient oxidation. During the second stage of the oxidation process there occurs a very rapid change in the structure of the spectrum. The visible band group rapidly disappears along with a more gradual fading of the ultra-violet bands until the characteristic absorption spectrum is entirely suppressed. These oxidation stages of hydrogenation observed by Zechmeister and his associates<sup>1</sup> and attributed to the saturation of two different groups of double bonds in the molecule.

The oxidation experiments also lend support to the contentions of Schertz<sup>2</sup> and others that the series of yellow xanthophylls described by Tswett as different pigments represent only different stages in the oxidation of a single pigment. Tswett's description of his xanthophylls is based principally on the positions of absorption bands in the visible spectrum. These positions are shown to correspond closely to successive changes in the absorption spectrum of xanthophyll during the slow oxidation process in solution.

The complete report on this subject will be published in the July number of the BUREAU OF STANDARDS JOURNAL OF RESEARCH.

#### DOMINANT WAVE LENGTH AND PURITY OF COLOR STIMULUS

In order to compute the dominant wave length and purity of a color stimulus by means of the "excitation" data of the Optical Society of America, two values must be obtained by interpolation. The adoption of the osculatory formula for this interpolation permits the computations to be made with perfect reproducibility. Each of the O. S. A. curves by this method is represented as a series of parabolas of the fifth degree which join at the values specified at every 10 millimicrons, so as to have a common slope and curvature at the junction point. Interpolated values have been computed according to this formula for every millimicron. Tables giving these data will be published in the July number of the BUREAU OF STANDARDS JOURNAL OF RESEARCH.

#### MEASUREMENT OF LENARD RAYS

An investigation is described in the July number of the BUREAU OF STANDARDS JOURNAL OF RESEARCH in which the correct measurement of the electron output (Lenard current) from high-voltage cathode-ray or Lenard-ray tubes is attempted.

The evidence presented shows that a Faraday chamber of proper dimensions may be used to measure the Lenard-ray current, which at any point is shown to be a linear function of the total tube current. The open-plate method of measuring Lenard currents yields results which are consistently too low, although under the conditions here used they bear a constant relationship to the Faraday-chamber measurements. The open-plate measurements are, therefore, also a linear function of the total tube current. The condenser method of measurement (Thaller) yields measurements above or below those of the Faraday chamber depending upon the relationship of the atomic numbers of the two plates. Moreover the current measured by this method is not a linear function of the total tube current, and hence does not bear a constant relationship to the Faraday-chamber measurements under the conditions used. Measurements of the range of scattered electrons from Lenard tubes operating at about 160 kv. peak, indicate a maximum of about 15 mm. in air which is equivalent to an energy of about 60 electron kilovolts. By means of a variable Faraday chamber described, it is possible to obtain a measure of the velocity distribution of the scattered electrons.

<sup>1</sup> Ber. d. Deut. Chem. Gesell., **61**, pp. 566, 1534, 2003; 1928; **62**, p. 2226; 1929.

<sup>2</sup> Plant Physiology, **4**, p. 337; 1929.

### DENSITY VERSUS COMPOSITION OF SODA-SILICA GLASSES

The studies on the relations between composition and density of soda-silica glasses has been continued, and some conclusions quite different from those previously reported in TECHNICAL NEWS BULLETIN No. 159 (July, 1930) have been reached. The method of preparation of the glasses is described in the previous reference. Fourteen additional glasses were made, and it now seems that relations between density and composition can be more accurately expressed by a series of linear equations than by the exponential equation formerly given. The specific volume (reciprocal of density) can be computed from  $V = a_1A + b_1B$ , in which  $V$  is specific volume,  $A$  and  $B$  are the percentages of silica and soda, respectively, and the values of the constants  $a_1$  and  $b_1$  are as follows in the indicated silica ranges:

Silica range (in per cent)	$a_1$	$b_1$
50 to 59.4.....	0.0042520	0.0035370
59.4 to 66.3.....	.0043028	.0034628
66.3 to 74.9.....	.0043922	.0032872
74.9 to 100.....	.0045400	.0028460

Of the 27 glasses on which these conclusions are based, 5 were in the first group, 6 in the second, 7 in the third, and 9 in the fourth. The average deviation  $\times 10^{-4}$  in these four groups is 9, 7, 6, and 8, respectively, the average deviation for the entire series being 7. The maximum deviation is 17.

It is interesting to note that the limiting silica values for the four groups mentioned above correspond quite closely to definite molecular ratios between silica and soda.

Similar results were obtained for relations between compositions and refractivities of these glasses and it seems quite probable that changes in density and refractivity of soda-silica glasses with composition can not be expressed by a single exponential equation or a single smooth curve, but that they should be expressed by simple equations or straight lines intersecting at certain molar compositions.

### VOLUME CHANGES DUE TO WEATHERING

Two years ago representative samples of wall tile, terra cotta, and dinner ware were selected and some of each kind were subjected to the autoclave test at the Columbus branch

of the bureau. Others were placed in a moisture saturated atmosphere and a third group exposed to the weather.

At the end of one year the samples exposed to the weather and those kept in the jar were measured and the permanent percentage increase in length was found to approximate roughly the findings by autoclave treatment, in some cases exceeding it and in some not reaching it. The samples in the jar showed increases much the same as those exposed to the weather, in several cases slightly in excess.

The measurements at the end of the second year have just been completed. In all cases except one the outdoor samples show figures well in excess of those subjected to the autoclave treatment, and the one exception is slightly below. The same is true in the case of those kept in the jar, all except one being in excess of the autoclaved samples. The exception here is not the same as the exception mentioned in connection with the outdoor samples.

More than half of the cases in the jar showed somewhat greater increases than the corresponding cases exposed to the weather.

### SOIL CORROSION STUDIES DURING 1930

During 1930 the bureau removed specimens representing 17 pipe materials from 70 soils. Most of the specimens are 8 years old, but 6, 4, and 2 year specimens are among those examined. The results of the examination of these specimens will be published in the July number of the BUREAU OF STANDARDS JOURNAL OF RESEARCH. The data are so varied and the factors affecting them so diverse that an understanding of the details of the experiment is essential to a full appreciation of the significance of the data. There are, however, a number of conclusions which are evident from even a casual examination of the data. As in the two previous reports, it appears that soil characteristics rather than the variety of the ferrous specimens tested control the character and amount of corrosion. In some soils one material or group of materials appears superior, but in another soil the reverse may be true, and as yet no one material has been shown to be best for all soil conditions. In a large number of soils it seems probable that any well-made material will give satisfactory service. Rates of corrosion appear to vary from year to year, as do apparent relative merits of materials, and for this and other reasons

it is believed that comparisons of materials should not be made until additional data have been secured.

A statistical study of the data shows that the standard error for the average performance of any one material in all soils is between 6 and 10 per cent. Considering the character of the investigation and the number of uncontrolled variables that influence the rates of corrosion, the precision of the data appears somewhat better than was expected. It should be remembered, however, that the data record only what has happened and not what will be the result at the conclusion of the work.

Rates of corrosion appear to decrease as the specimens grow older. As the rate of decrease has not been established for most of the soils under consideration, the life of the material in a given soil can not be predicted at this time. Indications are that for corrosive soils unless a satisfactory protective coating is assured it is advisable to use a pipe with a comparatively thick wall, since, whatever the material used, doubling the wall thickness will more than double the useful life of the pipe.

The data now available are helpful in the development of methods for making soil corrosion surveys. The purpose of such surveys is to predict the amount and character of coatings needed for the protection of pipe lines about to be laid or reconditioned.

Supplementary soil corrosion studies indicate that in well-defined soil series the corrosiveness is characteristic of the series, and rough estimate of the corrosion to be expected at any location within the series can be predicted upon experience elsewhere in that series. This indicates that ultimately the soil survey made by the Department of Agriculture will be helpful in determining the seriousness of soil action to be expected in many sections of the country.

#### ANALYSES OF SALTS USED FOR CURING HIDES AND SKINS

Stains and blemishes on hides and skins are a source of loss and annoyance to producers of leather. The presence of these imperfections often prevents the finishing of the leather in the desired colors and also causes a lack of uniformity in color which necessitates a lower quality grading of the material than would otherwise be the case. Unsatisfactory methods

of curing hides and skins contribute to the formation of stains, and troubles of this nature have been attributed to impurities existing in the salts used. In considering the seriousness of the problem, the Calf Tanners' Association raised the question as to the amounts of impurities occurring in the original salt (as distinguished from used salt) and requested the cooperation of the National Bureau of Standards in securing the information.

Twenty-nine representative samples of mined and evaporated salts produced in different geographical locations within the United States and used for curing hides and skins were selected for examination. The minimum and maximum amounts of the different chemical constituents which were determined quantitatively are given in the following table:

*Minimum and maximum amounts of the important constituents of rock and evaporated salts*

Chemical constituents	Type of salt			
	Rock		Evaporated	
	Minimum	Maximum	Minimum	Maximum
	Per cent	Per cent	Per cent	Per cent
Moisture.....	0.01	0.12	0.17	2.51
Insolubles.....	.20	1.90	.00	.50
Iron (Fe).....	.0000	.0003	.0000	.0002
Calcium (Ca) <sup>1</sup> .....	.09	.41	.22	.49
Magnesium (Mg) <sup>1</sup> .....	.00	.01	.01	.08
Sulphate (SO <sub>4</sub> ) <sup>1</sup> .....	.12	.74	.42	.67
Carbonate (CO <sub>3</sub> ).....	.00	.00	.00	.05

<sup>1</sup> In four samples of evaporated Ohio River salt, the calcium varied from 0.55 to 2.01, the magnesium varied from 0.24 to 1.00, and no sulphate was present.

Four samples were examined for insoluble iron and the amounts found varied from 0.0017 to 0.0123 per cent. Aluminum and silicate did not exceed 0.005 per cent in any sample. Qualitative tests showed arsenic and phosphate to be absent from all samples and boron to be present in minute quantities in two samples.

The work also included the analyses of six samples of foreign salts. One of these was a commercial denatured salt which contained 0.07 per cent of oil as determined by extraction with petroleum ether. Another salt was denatured with sodium carbonate as in-



licated by the high carbonate content found of 2.63 per cent.

The results are presented for the information of those interested in the influence of curing salts upon the formation of stains and blemishes. The report of this work was published in the *Journal of the American Leather Chemists Association*, Vol. XXVI, No. 6, June, 1931.

#### RELATION OF PAPER-MAKING PROCESSES TO STABILITY OF PAPERS

In connection with semicommercial experiments on the manufacture of bond types of papers from highly purified wood fibers, a study was made of the effect of the common variables in paper making, such as hydration, sizing materials, and alum, on the probable permanence of papers made from this fiber. The stability of the papers was measured by heating them at 100° C. for 72 hours and finding the degree of loss in desirable physical and chemical properties.

The amount of beating required to produce the desired strength and other characteristics in the papers was found to have no adverse effect upon their chemical properties and stability. The unsized papers had practically the same stability as the unbeaten pulp.

The stability of the papers was found to be definitely related to the amounts of rosin-sizing materials used. The use of excessive amounts of alum, which imparts acidity to paper, markedly decreased the stability of the papers, and the like effect, but to a lesser degree occurred with rosin. The minimum amounts of these sizing materials required for optimum writing quality were 1 per cent of rosin and sufficient alum to maintain the paper stock at 5 pH, and with these amounts papers of comparatively good stability were obtained. Modified beater-sizing starch, whether prepared by acid hydrolysis or by oxidation, had no deleterious effect on the stability of the papers.

Data illustrative of these findings are given in the table. Similar studies are being included in paper-making experiments on the other types of paper-making fibers.

#### Stability of experimental papers produced from highly purified wood fiber

Kind of sizing	pH of paper	Effect of heating for 72 hours at 100° C.	
		Retention of folding endurance in percentage of initial	Decrease in alpha cellulose content in percentage of initial
Unsize	6.6	96	0.5
Rosin (2 per cent)	5.5	69	1.4
Rosin (3/4 per cent)	3.8	35	6.6
Rosin (1/2 per cent), surface sized with glue without alum	4.9	81	1.1
Rosin (3/4 per cent), surface sized with glue containing alum	5.0	90	.7
	4.6	86	.5

#### NEW AND REVISED PUBLICATIONS ISSUED DURING JUNE, 1931

##### *Journal of Research*\*

Bureau of Standards Journal of Research, Vol. 6, No. 6, June, 1931. (RP. Nos. 314 to 328, inclusive.) Price, 40 cents. Obtainable by subscription; see footnote.

##### *Research Papers*\*

(Reprints from Journal of Research)

- RP292. Variations caused in heating curves of glass by heat treatment: A. Q. Tool and C. G. Eichlin. Price, 10 cents.  
 RP293. On the vibration of U bars: G. H. Keulegan. Price, 10 cents.  
 RP294. Laundry "winter damage": J. B. Wilkie. Price, 10 cents.

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RP295. The determination of the alpha cellulose content and copper number of paper; J. O. Burton and R. H. Rasch. Price, 10 cents.

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RP299. Two new crystalline difructose anhydrides from hydrolyzed inulin; R. F. Jackson and E. McDonald. Price, 5 cents.

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CS6-31 (Revision of CS6-29). Wrought-iron pipe nipples. Price, 5 cents.

#### *Commercial Standards Monthly\**

Commercial Standards Monthly, Vol. 7, No. 12; M June, 1931. Price, 10 cents. Obtainable by subscription; see footnote.

#### *Technical News Bulletin\**

Technical News Bulletin No. 170, June, 1931. Price, 5 cents. Obtainable by subscription; see footnote.

#### **OUTSIDE PUBLICATIONS\***

The unit of electrical resistance; past history and impending change. H. B. Brooks; Preprint of paper to be presented at summer convention of American Institute of Electrical Engineers (New York, N. Y.), June 22 to 26, 1931.

Benefits forecast from conference on weight laws. Ralph W. Smith; United States Daily (Washington, D. C.), Vol. VI, No. 82, p. 2; June 8, 1931.

Thermische ausdehnung von magnesium und magnesiumlegierungen. P. Hidnert and W. T. Sweeney (translated into German by Dr. Ing. Max Haas, Aachen, Germany); Zeitschrift für Metallkunde (Berlin, Germany), Vol. 21, p. 207; 1929.

Altitude laboratory tests of aircraft engines. H. K. Cummings and E. A. Garlock; Preprint of paper presented at fifth national meeting, American Society of Mechanical Engineers, aeronautic division (New York, N. Y.), May 12 to 14, 1931.

Altitude flights. H. B. Henrikson; Aero Digest (New York, N. Y.), Vol. 18, No. 6, p. 42; June, 1931.

On the direct determination of soda in soda-lime glasses by precipitation as uranyl zinc sodium acetate. F. W. Glaze; Journal, American Ceramic Society (Columbus, Ohio), Vol. 14, No. 6, p. 450; June, 1931.

What simplified practice has done for the construction industry. E. W. Ely; Mid Continent Purchaser (Tulsa, Okla.), Vol. 11, No. 23; May, 1931.

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